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INTELLOFAX 21

COUNTRY: Sweden/Netherlands/France/Germany

25X1A2g [redacted]

SUBJECT: Physical Metallurgy Research in Western Europe

PLACE ACQUIRED:-------

This unevaluated information for US Officials Only is 25X1A2g the possible interest of your analysts. It does not warrant dissemination by [redacted] report.

DATE ACQUIRED: Sep thru Nov 52

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SOURCE: US citizen, Ph. D., professor of physics at a well-known US university. In addition to teaching, he is working under contract to the US military establishment in the field of solid state physics and physical metallurgy. In the fall of 1952 he toured various physical metallurgy research centers in Western Europe where he compared research methods with techniques used in the US.

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Division of Physics I at The Royal Institute of Technology (Kungl Tekniska Hogskolan - KTH), Stockholm - 13 Sep 52

1. In the Division of Physics I Professor G. Borelius showed me the laboratories and outlined some of the work there. The laboratories are new and modern and very well built as is everything else in Sweden except the roads. Borelius and Berglund are promoting work on calorimetric studies of precipitation from solid solutions - such as the precipitation of nitrogen and α iron charged with nitrogen and heated to various temperatures to obtain equilibrium between nitrogen dissolved in α iron and the nitride Fe_4N. After quenching the nitrogen precipitation from the solution has been studied by measuring (at constant temperature) the power of the evolution of heat as a function of time. The precipitation of carbon dissolved in α iron was studied in the same way - by the heat evolved during precipitation. The power of the heat evolved during precipitation of carbon was measured as a function of time.

2. Some earlier work of the same type by Borelius, Larsson, and Selberg was concerned with the evolution of heat during disorder-order transformations in AuCu.

3. Another phase of the work in Borelius department is the measurement of magnetic atomic moments and the use of such measurements to examine the influence of cold working on such measurements in gold-chromium and copper-manganese alloys. The magnetic susceptibility of AuFe alloys has been investigated relatively recently and from the results it is possible to calculate the atomic paramagnetic moment of the iron atom. One can obtain a good idea of the direction of physical research in Sweden from a paper

in Arkiv für Fysik Band 5, #8 (1952) by E. Hulthen and E. Rudberg entitled "Reports from the Conference of the Swedish National Committee for Physics in 1951". This is a list of many of the physicists in Sweden together with a discussion of their recent work.

4. There is some infrared work done in Sweden but I did not have time to follow this up. The London office of ONR has a report of this work.

5. The KTH has a Department of Mining and Metallurgy which I did not visit because I could not find that anyone was interested in physical metallurgy. The Divisions of Mining and Metallurgy are as follows:

(a) Mineralogy and Geology
(b) Mining
(c) Ore Dressing
(d) Metallurgy of Iron and Steel
(e) Non-Ferrous Metallurgy
(f) Working and Treating of Steel
(g) Metallography
(h) Physical Metallography
(i) Heat Engineering
(j) Mining and Metallurgical Analytical Chemistry
(k) Mine Surveying
(l) Applied Geophysics
(m) Technology of Non Ferrous Metals

A detailed description of the activities and staff for all of these groups is given in a booklet put out by KTH and is called KTH Its Organization, Staff, Laboratories, and Current Research Work.

Philips of Eindhoven - 26 Sep 52

6. In a conversation with Dr. J. L. Meijering I had an opportunity to talk about his work in the metallurgy mainly of nonferrous alloys. Dr. Fast who was ill and not present deals mainly with ferrous alloys. With Meijering the discussion concerned mainly the hardening of metals by internal oxidation. The principal features of internal oxidation and hardening are covered in three papers.

Philips Research Reports

2	81-102	April 1947
2	260-280	August 1947

and Physical Society Bristol Conference Report page 140 (1948). I was interested in finding out whether this work was continuing and it turns out that they are doing only a little work on this topic.

7. It seems that Philips was not permitted to work on titanium and titanium alloys during the war and after the war they felt that they were so far behind that it would not pay to work in this field. I believe that the effects of titanium in steel are being studied here.

Societe Chemique Des Mureaux, Paris - 28 Oct 52

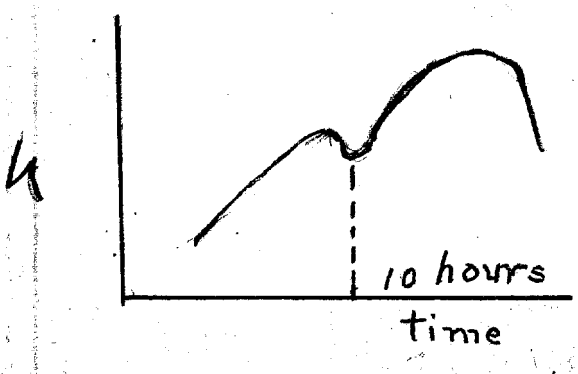
8. I met here a group of men executives and technical people concerned mainly with pigments for paints primarily oxides of lead. Apparently they are very much interested in sintered compacts of powdered metals because they were very curious about our ultrasonic attenuation work as a means of studying such materials. Among others I met Etienne Castaigue, George Moulier Paul Kemp and (fnu) Triboulin. This group wanted to know how samples of lead and antimony with small amounts of other materials would look to ultrasonic attenuation examination. A group of six or eight samples arrived some time ago and we found that these samples (which were primarily lead with amounts of antimony varying from 0 to 14%) were so highly attentuating that even as low as 3 to 5 megacycles the measurements were impossible. This large attenuation almost certainly arises because the material was sintered and sintered materials are usually very porous unless the sintering is very carefully done. Even when the material is well bound together the inhomogeneity may be high which means high scattering. I did not inquire very much about the work of this company because it did not seem to me to be of much interest.

L'Ecole Des Mines, Paris - 29 Oct 52

9. At L'Ecole des Mines in Paris I visited for a couple of hours with Professor Charles Crussard who is one of the best metallurgists in France. As it turns out Crussard has left the school of mines to take a job with the Institut de Recherches de la Siderurgie (IRSID) which is a new and very attractive laboratory concerned with research on iron and steel. I visited IRSID later.

10. At L'Ecole Des Mines Crussard told me about some experiments which he felt should be done in connection with the attenuation work we are doing at our laboratory. In particular, Crussard told me of some age hardening effects of which I was not aware and which should be detectable by ultrasonic attenuation methods. The material in question is Aluminum with about 4% copper prepared and quenched from 495°C. Maximum hardening occurs in about two days, and if slower hardening is desired one can allow the sample to age for a few days at room temperature and then heat for 5 minutes at 190°C and cool in air; the material now ages in one to two weeks instead of two days. Another alloy of interest in this regard is Al 4% Cu 1% Mg which ages more rapidly (4 to 5 hours) for maximum hardness (of 60 to 85). In these alloys there occur what are known in some quarters as Guinier

Preston Zones which are regions or zones which are copper enriched (although not pure copper) Al_2 Cu approximately. These zones in the preceding alloys are about 100 A° in size. The zones are not a new phase and are not a true precipitation. If now one ages these materials at 130°C there is an increase in hardness and after ten hours there is a peculiar dip in the hardness-time curve as shown.



This effect is not understood and Guinier observed (by Xray methods) a superlattice within the copper enriched zones. Some observers believe that the internal stress is relaxed as a function of time or perhaps as a function of the size of the "precipitation" zone.

11. Questions of this sort are of considerable importance in separating one effect from another in the behavior of alloys.

Institut de Recherches de la Siderurgie (IRSID)- 5 Nov 52

12. At the recommendation of Professor Crussard (mentioned in connection with L'Ecole Des Mines) who is now with IRSID, I visited Dr. Christian Boulanger at the IRSID laboratories. These laboratories which are quite new and very well equipped are located at St. Germain-en-Laye about 10 miles west of Paris. I found that Dr. Boulanger is concerned with studying the effect of various elements in iron - impurities, gases and so on - properties which affect brittleness, toughness, and fatigue. The testing laboratory which Boulanger showed me was quite impressive; this laboratory is equipped with quite a few machines (perhaps fifteen) for carrying on tests continuously and automatically with a record on each test run. This equipment is designed for small test specimens and all of the equipment is quite compact and well built. A set of photographs and some description of this equipment was given to me. I talked only with Boulanger while at IRSID. Crussard was away when I visited there and most of the other people available had interests quite far from mine. The director of the laboratory is Mr. G. Delbart.

13. The Institute fur Allgemeinen Metalkunde - 15 Nov 52

Personnel Interviewed: Professor Georg Masing
Dr. Kurt Lücke

14. I spent between two and three days at the Institute fur Allgemeine Metalkunde at Gottingen with Professor Masing and Dr. Lucke. Some of the problems in

physical metallurgy under investigation at the Institute were:

(a) Measurement of Activation Energy for Creep

(b) Measurement of heat of recrystallization

(c) Examination of stress-strain curve with 10 Angstrom resolution for attempting to see directly dislocation jumps. Unsuccessful so far.

(d) X-ray Techniques -
Guinier x-ray methods to study slip systems.
(Aluminum single crystals used in many of these experiments).

(e) Measurement of the effect of impurities in iron (such as carbon) on electrical conductivity - Measurement of effect of plastic deformation on electrical conductivity.

15. Professor Masing and Dr. Lücke seem to me to be two of the best physical metallurgists that I met in Europe. I like the types of problems in physical metallurgy which they select to study. Dr. Lücke has accepted an invitation to come to work in a metals research laboratory in the US for a year or possibly two years. G. Masing is the author (with Lücke) of a treatise on metallurgy which is well known in Europe.

16. The equipment at the Institut für Metalkunde is now quite good; the x-ray equipment for the Guinier work on slip systems is very good and the high vacuum melting system is exceptionally good. A complete description of this equipment is attached because I believe it has advantages that cannot be bought in equipment now available in the United States. This is especially true if one considers cost, flexibility, and nicety of design.

17. I am particularly anxious to keep in touch with people at the University in Gottingen and I intend to ask the Air Forces for help in this connection.

Vacuumschmelze Aktiengesellschaft-Hanan - 17 Nov 52

Presonnel Interviewed: Dr. M. Kersten
Dr. Dreisinger, Director

18. Dr. M. Kersten showed me practically all of the vacuumschmelze plant. This company is engaged in the manufacture of metals and alloys for rather special applications, including strictly scientific developments.

19. The activities of Vacuumschmelze include the following:

(a) Resistance alloys for electrical heating purposes - alloys of chromium-nickel, chromium-iron-aluminum, and nickel iron. Supplied in wire form, all sizes and surface conditions.

(b) Heat-resisting high temperature alloys in chromium-nickel and chromium-silicon - iron in rods, wire, sheet, tape or tubes.

(c) Thermal-expansion alloys and alloys for Bi Metallic strips and similar applications. The alloys in this category must have accurately determined thermal expansion. Materials with high and low expansivity with temperature in a certain temperature range are required. Complete information on these products is available from a catalog entitled "Expansion Alloys and Alloys for sealing into glass".

(d) Various Ni-Co-Fe, Ni-Fe, Ni-Cr-Fe, Cr-Fe, Mu-Cu alloys for glass to metals seals primarily for vacuum tube fabrication together with metals and alloys for vacuum tube parts especially pure nickel, pure copper, pure iron. Various composite materials such as tungsten disks set in copper so that bond is good for heat transfer, nickel clad copper wire. A complete description of the vacuum tube component work is described in a catalog entitled "Valve construction and electronic materials".

(e) Soft Magnetic Alloys for transformers relays, magnetic shields, high permeability tapes for toroids, etc. are melted, rolled, and heat treated at Vacuumschmelze. The manufacture of high permeability material is difficult and a large amount of effort is devoted to this work.

(f) Alloys for thermocouples, resistance thermometers, and pyrometer shields - in the form of rods, wires, strips and tubes. The vacuum melting techniques are particularly good for obtaining reliable thermo-electric materials.

(g) Beryllium and Beryllium Alloys. Alloys of copper-beryllium, nickel-beryllium, cobalt-beryllium, nickel-beryllium-titanium, chromium-nickel-beryllium, and the same with molybdenum are all made by Vacuumschmelze. The copper-veryllium alloys are of course well known for membranes, springs, current brushes, bearings, non-magnetic ball bearings, etc.

20. I had an opportunity to see the vacuum melting furnaces, the rolling mills, the mechanical and electrical testing laboratories.

21. Through Dr. Kersten I met Dr. Dreisinger, the director of the laboratory at Vacuumschmelze, who agreed to supply us with certain forms of pure iron and nickel for attenuation measurements.

22. Dr. Kersten came to the western part of Germany relatively recently; he had been in the eastern zone at the University of Jena, I believe.

University of Munich - 21 Nov 52

23. Examination of the homogeneity of sintered nickel-copper powder mixtures by magnetic methods has been undertaken by J. Kranz. One interesting section of the work of J. Kranz is the study of Barkhausen oscillations in a statistical manner by means of counters as the material is moved slowly into or out of a magnetic field. Some excellent evaporation equipment made by Balzers in Lichtenstein has been provided for this laboratory through funds from the US.

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